

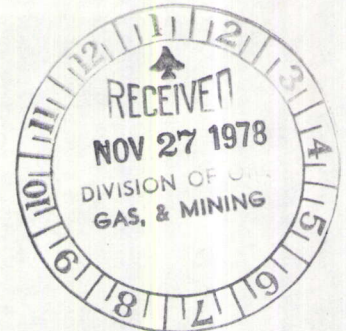
EDWARD F. CARPENTER, P.E.  
~~EDWARD F. CARPENTER, P.E., E.S.~~

## PLATEAU ENGINEERING, INC.

Consulting Civil Engineers

840 ROOD AVENUE  
GRAND JUNCTION, COLORADO, 81501  
(303) 245-1310

November 14, 1978



Allied Mission Oil Company  
c/o Dr. Robert Young  
612 Rico Court  
Grand Junction, CO 81501

Dear Dr. Young:

Attached is my report on the mine waste discharge of the Vanadium Queen Mine, San Juan County, Utah.

As a result of the extensive testing, we recommend an Ammonium Hydroxide - Ferric Sulphate precipitation process for removing the toxic pollutants. Because of the expense involved, we did not carry the testing far enough to completely define the optimum dosage, nor to test for radium removal. The literature reveals that at least 90% removal of radium can be expected.

The use of a chemical feeder for the Ferric Sulphate is recommended, but a home made feeder using a steel drum and petcock feeder will probably suffice, although the amount of chemical used cannot be as closely controlled. It is also recommended that the Ammonium Hydroxide be purchased in 100 lb. bottles under pressure, which requires only a regulator and injector feeder. A standard platform scale can be used to monitor the rate of feed.

A detention pond of smaller size would be adequate provided some recirculation by air pressure or pumping was provided. Therefore, the pond size was increased in the belief that a few cubic yards of excavation was less expensive than the recirculation required. The longer precipitation time is calculated to be adequate, even when the pond is partially filled with precipitate.

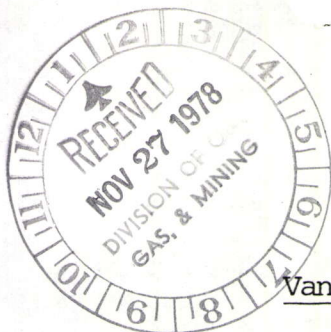
It has been a pleasure to do this work for you, and we appreciate the opportunity to serve you.

Very truly yours,

Edward F. Carpenter, P.E.  
Utah Professional Engineer No. 4000

EFC:emb





## REPORT OF TREATMENT

### Vanadium Queen Mine - Water Discharge

This office was requested by Dr. Robert G. Young in early September, 1978, to investigate the mine water discharge from the Vanadium Queen Mine, San Juan County, Utah. This has been done by:

- a. Visit to mine, taking samples of the discharge and making a topographic survey of the site of a possible treatment pond.
- b. Researching the literature for alternate treatment methods and their applicability.
- c. Laboratory work to verify treatment process.
- d. Prepare preliminary cost estimate of treatment and resource recovery.
- e. Prepare conclusions and recommendations.

I. The Vanadium Queen Mine is located in San Juan County, Utah in Section 29, Township 28 South, Range <sup>26 East SLBM</sup> 7 East, Uinta Base and Meridian, at elevation 6,780, draining to a south-flowing intermittent tributary of La Salle Creek, in the Dolores River Basin.

A water discharge from the mine flows westerly over the edge of the mine area, along and over the tailings pile to the stream bed, approximately 150 feet below the mine mouth. The flow of discharge was measured several times, the average of measurements being 2.7 gallons per minute (.006 c.f.s.). The pH was measured at 8.4.

The topographic survey shows the proper relationship between land features and shows a potential site for treatment facilities south of the tailings pile.



The water sample was delivered to Technology Management, Inc., Mr. Carlon C. Chambers, P.E., Consulting Chemical Engineer, for testing and advise on proper treatment methods.

II. Research and Laboratory Work - Mr. Chambers tested the sample and generally verified the State Health Department analysis of toxic pollutants. His search of the technical literature showed that a Barium Chloride precipitation process was the most widely accepted. His preliminary report, dated September 22, 1978, is attached.

After submitting this report, a conference with Dr. Robert Young suggested that an alternate process using Ammonium Hydroxide might offer better results in removal of radium, which the State Health Department indicated was the most critical toxic. Accordingly, Dr. Young provided a 10-gallon sample of discharge and a series of tests were performed using Ammonium Hydroxide - Ferric Sulphate precipitation process. This process appears to be as effective as the Barium Chloride process with respect to all of the pollutants except radium, which required a pH manipulation that appeared to present some practical difficulties in the operation of the Barium process. The Ammonium Hydroxide - Ferric Sulphate process is revealed in the literature to be effective in removing radium and test results show the effectiveness in removing the other toxics: uranium, arsenic and selenium. Mr. Chambers' report dated November 8, 1978, is attached.

It should be noted that the chemical cost of the Ammonium Hydroxide - Ferric Sulphate process is about one-third of the chemical cost of Barium Chloride process. Since the Barium Chloride is itself a toxic, an excess of other chemicals is required in the effluent discharge to prevent further pollution. The alternate process raises the ammonia level in the effluent, and if fish are present in the receiving waters, this may pose a problem. Since the tributary stream is intermittent, it seems likely that the hazard to fish is minimal.



The resource recovery is estimated as follows at the treatment level recommended:

<u>Element</u>	<u>Reported Level of Concentration</u>	<u>Estimated Recovery Rate</u>	<u>Amount Recovered per Year</u>
Uranium	1.06 ppm	100%	7.67 lbs.
Radium	66 pc/li	90%	$295 \times 10^6$ pc
Arsenic	.17 ppm		1.86 lbs.
Selenium	.03 ppm		.33 lbs.

Additionally, measurable amounts of Magnesium and Boron would also likely be found in the precipitate but were not tested.

Cost of chemicals for treatment is estimated to be up to \$3.00/day for the ammonium process and up to \$7.00/day for the Barium process. The capital investment in a 48-hour retention pond and feeders for the chemicals, piping for effluent and influent is attached as a Preliminary Estimate of Costs. A preliminary design is shown on the topographic map and is also attached.

#### Summary and Conclusions

1. The Vanadium Queen Mine discharges approximately 2.5 gpm of water which contains pollutants not permitted in a stream discharge.
2. The pollutants can best be removed from the discharge by a chemical precipitation process. The better of two which were investigated is an Ammonium Hydroxide - Ferric Sulphate process.
3. Testing did not completely define the optimum dosage but at the assumed dosage of 200 ppm, it appears that all of the pollutants will be removed or substantially reduced.

4. The annual cost for 5 year life at 8% interest for plant investment is \$1,202. The annual cost for operation and maintenance of the facility is \$4,180.

5. At present prices, it appears that recovery of the metals precipitated to the pond will repay a portion of the costs of this anti-pollution installation.



Pond for Precipitation

$$2.5 \times 1440 \times 2 = 7200 \text{ gal.} = 962 \text{ cu.ft.}$$

$$\text{Assume } 3' \text{ SWD} = 320 \text{ sq.ft. area}$$

$$\begin{aligned} 2' \text{ SWD} &= 481 \text{ sq.ft.} = 22' \times 22' \times 2' \text{ water depth} = 4' \text{ pond depth} \\ &= 1925 \text{ cu.ft.} = 75 \text{ cu.yd. excavation} \end{aligned}$$

$$\text{Chemical Feeders } 1.53 \text{ lbs./day } \text{NH}_3$$

$$6.0 \text{ lbs./day } \text{Fe}_2(\text{SO}_4)_3$$

Preliminary Estimate of Cost

Excavation - 100 cu.yd. @ \$5.00/yd.	\$ 500
Mixing Pipe - 100 ft. - 8" CMP @ \$12.00/ft.	1,200
Inlet Piping - 550 ft. - 2" PVC @ \$2.00/ft.	1,100
"Advance" Chemical Feeder - Sulphate-Installed	1,500
Regulator-Feeder-Ammonia	500
	<hr/>
	\$4,800

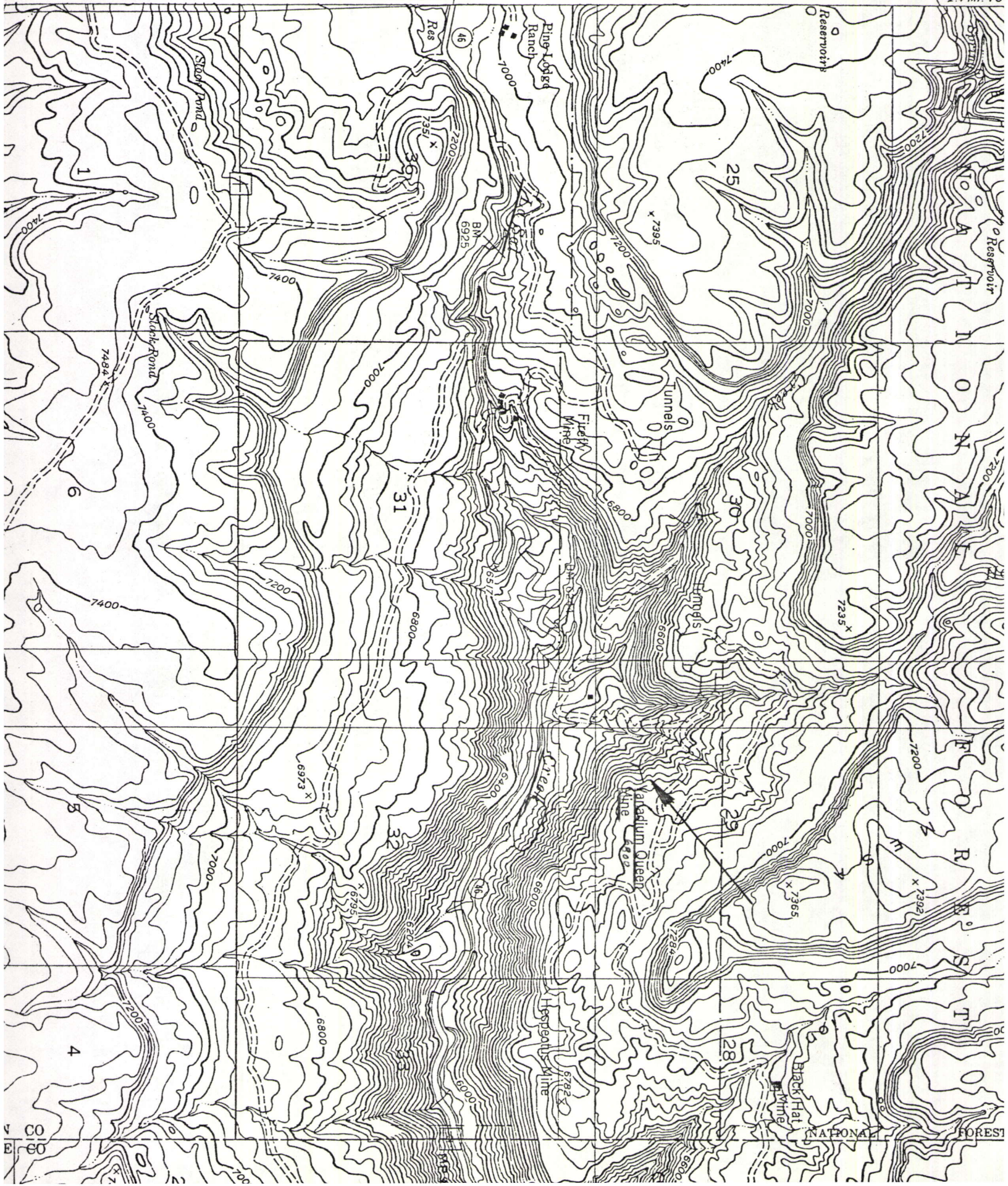
$$5 \text{ yrs} - 8\% = \$1,202/\text{yr.}$$

Preliminary Estimate - Operation and Maintenance

Labor - Average 1 hr./day @ \$10.00	\$2,080
Chemicals	1,100
Administration, Reports, Monitoring, Tests, etc.	1,000
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	\$4,180



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JOHN C. K. HART & CO.  
GRAND JUNCTION LABORATORIES

435 NORTH AVENUE

PHONE 242-7618

GRAND JUNCTION, COLORADO 81501

ANALYTICAL REPORT

Received from: **Technology Management Inc.**

Customer No. \_\_\_\_\_ Laboratory No. 626 Sample Water

Date Received Oct. 25, 1978 Date Reported Nov. 1, 1978

Sample

*Influent*  
#3701

Uranium(U)	1.06	mg/L
Arsenic(As)	0.17	"
Selenium(Se)	0.00	"
Ammonia(N)	0.26	"
Dissolved Solids	324	"

*Effluent*  
#3702

0.36	mg/L
0.00	"
0.00	"
26.8	"
322	"

*7.11.78  
2.0*

By \_\_\_\_\_